THE PORTABLE LIME LIGHT.

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Since the discovery of the oxyhydrogen or Drummond light little improvement was made in apparatus to generate the gases until Ives of Philadelphia (some eight years ago) invented what he called the ether saturator to furnish the hydrogen. As all are familiar with this apparatus it need not be described. Suffice to say, it replaced the large hydrogen gas bag and generator, but left the oxygen gas bag, generator, and weights or, in its place, a large cylinder of compressed gas. Professor Fairchild, of Oberlin, Ohio, has gone a step farther and made an apparatus to generate both gases, which he calls "The Portable Lime Light."

A point upon a piece of unslacked lime brought to a dazzling incandescence by the sharply driven jet of the oxyhydrogen flame has proved itself to be by far the most satisfactory light for lantern use. This is due to the intensity of its illuminating powers, its emanation from a very small and fixed area, and its steadiness. The electric arc light is a rival in intensity, but it lacks in steadiness, and the point of light is constantly changing, both from the wearing away of the carbon and the shifting of the arc from side to side and from front to back. All oil lights are greatly deficient in illuminating power, and the light is spread over so long a space that the lenses cannot properly gather the rays together. The oxyhydrogen jet is formed by driving under some pressure a hydrocarbon gas through one channel and pure oxygen gas through another channel to a small chamber where they are thoroughly mixed just before igniting. Each gas is perfectly safe by itself, but the proper mixture is explosive. If a somewhat strong pressure is maintained the flame is never carried back, but should the pressure be relaxed for an instant an explosion of whatever mixed gas there is follows at once. If this amount is small the annoyance of a *pop* is the only result, but if there are large reservoirs of gases and by some chance those become mixed most serious results both to life and property have sometimes occurred.

The amount of pressure that can be used depends upon the character of the lime, the accurate mixture of the gases, and the smoothness and perfect shaping of the bore of the nipple that forms the jet. The stronger the pressure the better the light, until the jet begins to spray, as it were, when hissing sets up and the light is impaired. This pressure, when measured by the height of a column of water which it will sustain, varies from eight to twenty or, under unusually happy conditions, twenty-four inches. This means from five to fifteen ounces of pressure per square inch of surface, amounting with the larger gas bags to hundreds of pounds of weight. In using cylinders the pressure is reduced to the required amount by most careful regulation of the cylinder stop-cock. To maintain a good lime light, whatever be the source of gas supply, an operator must have some native skill, a good deal of experience, and must give constant attention to his work. The drawbacks to the use of the lime light are the time and cumbrous machinery needed to manufacture and store the gases, or, if cylinders are used, the cost of the gases, the expense of transportation, and the danger of not having cylinders when needed at all times and in all sorts of places.

In a few pounds of the chlorate of potash or a few pints of liquid, Nature packs away as much oxygen or hydrocarbon gas as the pumps can pack with the largest cylinder. To draw the gases as needed from Nature's packages has been the problem to be solved, and after years of experience it is believed that the portable lime light apparatus meets all the conditions required. For the hydrocarbon elements the vapor of gasoline has been used as from an ordinary gasoline stove. Gasoline is cheap, is well known, and is everywhere available. Let any one study an ordinary gasoline stove in his own kitchen or that of his neighbor, and he will understand how the gas is obtained from the liquid. There is a generating tube three-fourths of an inch in diameter and some five or six inches in height, which is so heated that at the top the temperature is above the boiling or gas-producing point of gasoline, while the base of the tube is kept below that point. From the top of the tube, therefore, gas can be drawn off in an ample and steady supply, the liquid rising to the more heated part and vaporizing as required. The needed pressure can be obtained in two ways—by raising the supply tank, as in the ordinary stove, or by pumping into a closed supply tank by hand bulb, an air pressure. The latter form has been chosen as being the most convenient, and the pressure is always greater than can be used at the jet of the lime light. The only limiting condition is that the

channel leading the gas to the mixing chamber must be kept heated above the boiling point of gasoline, and for this the apparatus amply provides.

The oxygen gas is obtained from the ordinary chlorate of potash, to which is added, as usual, a third part of the binoxide of manganese, that the gas may come off steadily and at a lower temperature. The principle involved in this apparatus is the heating of small portions of the chemicals as the operator sees his need of gas. The gas as made is carried into a small pressure or regulating bag, so that the supply is constant and at a steady pressure.

In order that only a portion of the chemicals may be heated at once the retort is made of a poor heat-conducting material, like tin or German silver, aud is but two inches in diameter and some two feet in length. The diameter being so small, tin is found to be abundantly strong. The necessary heat is obtained from the gasoline heater, this heater also being required to keep the gasoline-generator tube hot. The operator places one end of this oxygen retort over the heat, and in a moment the gas begins to bubble through the wash-bottle, and the regulating bag begins to fill. When the flow slackens and more gas is needed, the tube is slid along about an inch. Practically this amount of attention is not felt by the operator after he has become thoroughly acquainted with his apparatus. The oxygen-regulating bag is constructed upon a new principle. It is a strong rubber-cloth bag, cylindrical in form, two feet in length, and eleven inches in diameter when filled. It holds about ten minutes' supply of gas. The pressure is obtained by a dozen or more strong rubber bands, which close the bag and tend to keep it closed. As the bag fills and the outward pressure surface becomes greater, the tension of the stretching rubber bands increases in about the same ratio. It is very easy, by adding more rubber bands, to obtain all the pressure that can be used. In working, the bag is kept at nine or ten inches in diameter. It is light, occupies when empty but small space, and is a great relief over anything operated by weights. In construction this gas-making apparatus is so arranged that it becomes the framework of the lantern.

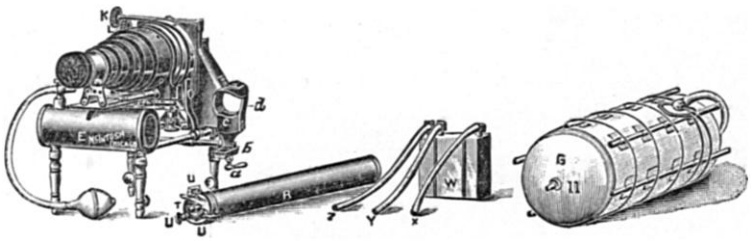

FIG. 1.—Apparatus disconnected.

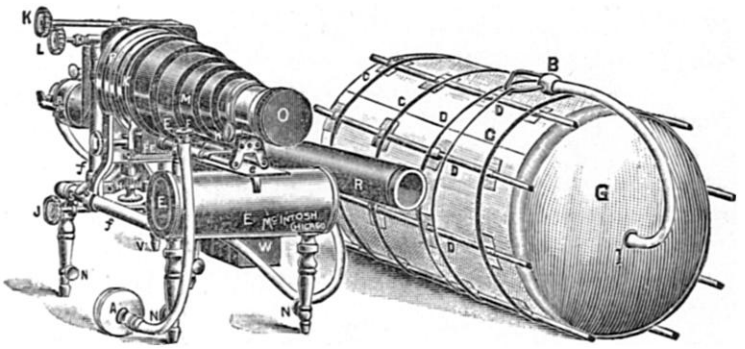

FIG. 2.—Apparatus connected (front view).

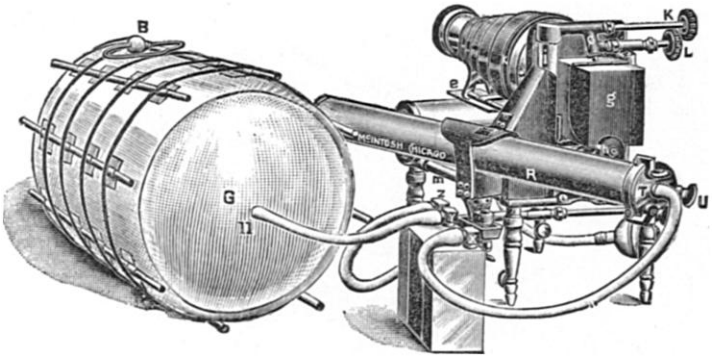

FIG. 3. —Apparatus connected (back view).

A—Pump.
B—Safety valve.
C C C—Rubber bands.
D D D—Rods.
E E—Gasoline reservoir.
F—Needle valve on gasoline tank of milled-head thumb-screw.
F F—Needle valve and stopper on gasoline tank.
G—Gas bag.
H—Milled-head thumb-screw for raising or lowering optical system.
I—Milled-head thumb-screw for moving optical system from right to left and *vice versa*.
J—Valve admitting liquid gasoline to valve "*a*" of generator burner.
K—Valve regulating supply of gas.
L—Valve regulating supply of oxygen.
M—Telescope rod to lantern front.
N—Thumb-screw for adjusting telescope legs.
O—Objective.
P—Base cells holding condensing lenses.
Q—Mixing chamber to jet.
R—Retort.
S—Milled-head thumb-screw for holding front in place.
T—Nipple of the retort.
U—Clamps of the retort.
V—Nipple admitting oxygen to pipe from wash-bottle "Z."
W—Wash bottle.
X—Inlet to wash-bottle.
Y—Outlet from wash-bottle to gas-bag nipple "L L."
Z—Outlet from wash-bottle to "V" or oxygen nipple.
a—Valve letting liquid gasoline into cup of gasoline burner.
b—Cup of generator burner, to be filled with liquid gasoline by turning valve "*a*."
c—Generator.
d—Place for retort.
e—Plate on which the telescope hood moves forward or backward and is fastened in position by thumb-screw under plate.
f—Pipe through which oxygen passes.
g—Hood covering the lime light.
h—Milled-head thumb-screw for moving lime forward or backward. Under the hood, not shown in cut, is a thumb-screw for raising or lowering the lime.
i—Pipe carrying gasoline vapor.
k—Slide box.
l—Nipple on gas bag for connecting the safety-valve "B."
l l—Nipple on gas bag for connecting wash-bottle "Y."
m—Pipe from gasoline tank to valve "J."
n—Objective rack and pinion for fine adjustment.

When the focus is once adjusted it is never afterward disturbed, save to slide the lenses back and forth for the varying distance of the screen. This apparatus and the lantern are practically one, and the whole, including two oxygen retorts, the wash-bottle, and the bag, can be packed in a very small compass and can easily be carried by one hand. The expense of operating, both in time and money, is very small. The gasoline costs hardly more than one cent an evening and takes no more time than it does to fill an ordinary oil lamp. The cost of the oxygen varies with the price of chemicals, some two pounds being used. None is ever wasted, the unused material falling away when the retort is opon. Ten minutes is all the time required from the unstrapping of the packing case to the lighting of the jet. The cleaning up and recharging can be done at any time and will take fifteen or twenty minutes. The question of safety is one of prime importance for an instrument used in public halls and private parlors. The danger from gasoline is due to the carelessness in filling or in cleansing the cocks not fully turned off. The use of the air pressure avoids both these causes of accidents. The tank is very strong and air-tight and holds only about a pint at the most. There is only a cubic inch or so of gas at any time and absolutely no chance of mixture. In oxygen manufacture the only point of activity is an inch in length of the two-inch tin retort. Care is needed to see that the chemicals are tested for purity, and that they are thoroughly mixed, and that the larger crystals are crushed somewhat and not allowed to gather in one place in the retort, and specially that no piece of paper or some organic substance slip into the retort; but even with great carelessness the conditions of a serious accident are wanting. These, then, are the characteristics of a portable lime-light apparatus. It is safer from serious accidents than any other form of the oxyhydrogen jet yet devised, for even cylinders sometimes burst. The mixing of the gases and their issuance from the nipple and the pressure obtained differ in no essential from the results procured by the best apparatus now in use. It is economical both as to time and expense. If packed up properly charged, it is ready to be taken in the hand at any time and set up for use in any place without a moment's warning.